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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/998,787	10/31/2001	Tien-I Bao	TS00-863	8702

28112 7590 03/14/2003

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EXAMINER	
PERKINS, PAMELA E	
ART UNIT	**PAPER NUMBER**
2822	

DATE MAILED: 03/14/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/998,787	BAO ET AL.	
	Examiner	Art Unit	
	Pamela E Perkins	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 October 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-29* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *31 October 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

This office action is in response to the filing of the application papers on 31 October 2001. Claims 1-29 are pending.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-5, 8, 10, 12-16 and 20 rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo et al. (6,472,755) in view of Givens et al. (6,080,655).

Ngo et al. disclose a method of copper metallization in the fabrication of an integrated circuit device where an opening (21) is formed in a dielectric layer (20) overlying a substrate; forming a copper layer (23) within the opening (21); coating the copper layer (23) with an oxide layer (24) and depositing a silicon nitride or silicon carbide capping layer (50) on the oxide layer (24). Ngo et al. further disclose heating the substrate in a deposition chamber using a NH_3 plasma. Ngo et al. also forming the copper layer (23) using a physical vapor deposition (PVD) process, a chemical vapor deposition (CVD) process, electroplating or electroless plating (Fig. 2 & 4; col. 6, lines 24-60). Ngo et al. do not disclose the substrate having semiconductor structures such as gate electrodes, source and drain regions, lower level metallization; the opening connecting the a semiconductor structure and forming a copper layer within and over

the opening and then using a CMP process to polish back the copper layer to only within the opening.

Givens et al. disclose a method of copper metallization where an opening (42) is formed in a dielectric layer (50) overlying a substrate (20); forming a copper layer (60) within and over the opening (42); using a CMP process to polish back the copper layer (60) to only within the opening (42) and then depositing a capping layer (252) on the copper layer (60). Given et al. further disclose forming the copper layer (44) using a PVD process, a CVD process, electroplating or electroless plating (Fig. 1D; col. 5, lines 1-58). Givens et al. also disclose the substrate having semiconductor structures such as gate electrodes (24), source and drain regions (22), lower level metallization and the opening (42) connecting the a semiconductor structure (Fig. 1A; col. 4, lines 3-64).

Since Ngo et al. and Givens et al. are both from the same field of endeavor, a method of copper metallization, the purpose disclosed by Givens et al. would have been recognized in the pertinent art of Ngo et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Ngo et al. by the substrate semiconductor structure such as gate electrodes, source and drain regions, lower level metallization; the opening connecting the a semiconductor structure and forming a copper layer within and over the opening and then using a CMP process to polish back the copper layer to only within the opening as taught by Givens et al. to fill the opening without creating any voids (col. 5, lines 48-55).

Claims 6, 9, 11, 17, 19, 21, 22-27 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo et al. in view of Givens et al. as applied to claims 1-5, 8, 10, 12-16 and 20 above, and further in view of Law et al. (5,589,233).

Ngo et al. disclose a method of copper metallization in the fabrication of an integrated circuit device where an opening (21) is formed in a dielectric layer (20) overlying a substrate; forming a copper layer (23) within the opening (21); coating the copper layer (23) with an oxide layer (24) and depositing a silicon nitride or silicon carbide capping layer (50) on the oxide layer (24). Ngo et al. further disclose heating the substrate in a deposition chamber using a NH_3 plasma. Ngo et al. also forming the copper layer (23) using a physical vapor deposition (PVD) process, a chemical vapor deposition (CVD) process, electroplating or electroless plating (Fig. 2 & 4; col. 6, lines 24-60). Ngo et al. do not disclose forming the oxide layer and capping layer in a plasma-enhanced CVD chamber at between 200 ^{o}C and 600 ^{o}C in less than 24 hours.

Law et al. disclose a method of copper metallization where a substrate (38) is placed in a deposition chamber (12) that has an oxide layer formed on the walls of the chamber (col. 3, lines 41-46). Law et al. further disclose forming a layer on the substrate (38) in a plasma-enhanced CVD chamber at between 200 ^{o}C and 600 ^{o}C in less than 24 hours (col. 4, lines 21-63).

Since Ngo et al and Law et al. are both from the same field of endeavor, a method of copper metallization, the purpose disclosed by Law et al. would have been recognized in the pertinent art of Ngo et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Ngo et al. by

forming the oxide layer and capping layer in a plasma-enhanced CVD chamber at between 200 ^{o}C and 600 ^{o}C in less than 24 hours as taught by Law et al. reduce contamination of the substrate (col. 2, lines 58-63).

Referring to claims 7, 10, 18, 20 and 28, Ngo et al. do not disclose the oxide layer having a thickness between 10 and 10,000 Angstroms and the capping layer having a thickness between 1000 and 2000 Angstroms. It would have been obvious to one having ordinary skill in the art at the time invention was made to the oxide layer having a thickness between 10 and 10,000 Angstroms and the capping layer having a thickness between 1000 and 2000 Angstroms disclosed in the claimed invention, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Marieb et al. (2002/0076925) disclose a method of forming an oxide layer on a copper layer and then forming a capping layer on the oxide layer.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E Perkins whose telephone number is (703) 605-4299. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

pep
March 10, 2003

AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800